AMENDMENTS TO THE SPECIFICATION

Please replace paragraph **[0047]** with the following amended paragraph:

[0047] According to a fourteenth aspect of the invention, there is provided the electric field sensor according to the thirteenth aspect of the invention, wherein the light incident to the electro optic crystal is an optional polarized light, and the compensating means includes: a quarter wave plate of which electric main axis coincides with a main axis of an elliptically polarized light emitted from the electro optic crystal, and which converts the elliptically polarized light into a linearly polarized light; and a half wave plate that adjusts an angle of a polarization surface of the linearly polarized light emitted from the quarter wave plate based on a fact that an angle formed between an electric main axis of the half wave plate and the electric main axis of the electro optic crystal is [[$n \cdot 45° - \phi o/2$]] $\underline{n \cdot \pi/4 - \phi_o/2}$ (where n is an integer) when an angle formed between the polarization surface of the linearly polarized light from the quarter wave plate and the electric main axis of the electro optic crystal is [[$45° - \phi o$]] $\underline{\pi/4 - \phi_o}$ without the electric field applied.

Please replace paragraph **[0048]** with the following amended paragraph:

[0048] According to a fifteenth aspect of the invention, there is provided the electric field sensor according to the thirteenth aspect of the invention, wherein the light incident to the electro optic crystal is a linearly polarized light of which a polarization surface forms an angle [[$45°$]] $\underline{\pi/4}$ with an electric main axis of the electro optic crystal, and the compensating

means includes: a quarter wave plate of which an electric main axis forms an angle [[45°]] $\underline{\pi/4}$ with the electric main axis of the electro optic crystal, and which converts an elliptically polarized light emitted from the electro optic crystal into a linearly polarized light; and a half wave plate that adjusts an angle of a polarization surface of the linearly polarized light emitted from the quarter wave plate based on a fact that an angle formed between an electric main axis of the half wave plate and the electric main axis of the electro optic crystal is [[n·45°-φo/2]] $\underline{n \cdot \pi/4 - \phi_o/2}$ (where n is an integer) when a phase difference included in the elliptically polarized light emitted from the electro optic crystal is [[φo]] $\underline{\phi_o}$ without the electric field applied.

Please replace paragraph **[0049]** with the following amended paragraph:

[0049] According to a sixteenth aspect of the invention, there is provided the electric field sensor according to the thirteenth aspect of the invention, wherein the light incident to the electro optic crystal is a circularly polarized light, and the compensating means includes: a quarter wave plate of which an electric main axis forms an angle [[45°]] $\underline{\pi/4}$ with an electric main axis of the electro optic crystal, and which converts an elliptically polarized light emitted from the electro optic crystal into a linearly polarized light; and a half wave plate that adjusts an angle of a polarization surface of the linearly polarized light emitted from the quarter wave plate based on a fact that an angle formed between an electric main axis of the half wave plate and the electric main axis of the electro optic crystal is [[n·45°-φo/2]] $\underline{n \cdot \pi/4-}$

$\underline{\phi_o/2}$ (where n is an integer) when a phase difference included in the elliptically polarized light emitted from the electro optic crystal is [[φo]] $\underline{\phi_o}$ without the electric field applied.

Please replace paragraph **[0050]** with the following amended paragraph:

[0050] According to a seventeenth aspect of the invention, there is provided the electric field sensor according to any one of the fourteenth to the sixteenth aspects of the invention, wherein [[φo]] $\underline{\phi_o}$ is determined based on [[φo=(2π/λ)(no-ne)L]] $\underline{\phi_o=(2\pi/\lambda)(n_o-n_e)L}$, where

Please replace paragraph **[0051]** with the following amended paragraph:

[0051] [[no]] $\underline{n_o}$ is a refractive index of the electro optic crystal for ordinary light,

Please replace paragraph **[0052]** with the following amended paragraph:

[0052] [[ne]] $\underline{n_e}$ is a refractive index of the electro optic crystal for extraordinary light,

Please replace paragraph **[0053]** with the following amended paragraph:

[0053] λ is a wavelength (meter) of light in vacuum, and

Please replace paragraph **[0054]** with the following amended paragraph:

[0054] L is a length (meter) of the electro optic crystal in the direction of light.

Please replace paragraph **[0058]** with the following amended paragraph:

[0058] In order to achieve the above objects, according to a twenty-first aspect of the invention, there is provided a method of adjusting an electric field sensor including: a light source; an electro optic crystal which is applied with an electric field based on a signal under test, in which a birefringent index changes according to the electric field, and which changes a polarization state of incident optional polarized light according to the birefringent index and emits the light; a pair of electrodes for applying the electric field based on the signal under test to the electro optic crystal; and a detector that splits the light emitted from the electro optic crystal into a P polarized light component and an S polarized light component, and obtains an alternate current signal corresponding to a difference between intensities of the respective polarized light components, the method including: providing a quarter wave plate that converts an elliptically polarized light emitted from the electro optic crystal into a linearly polarized light such that an electric main axis of the quarter wave plate coincides with an electric main axis of the elliptically polarized light; and providing a half wave plate that adjusts an angle of a polarization surface of the linearly polarized light emitted from the quarter wave plate such that an angle formed between an electric main axis of the half wave plate and the electric main axis of the electro optic crystal becomes [[n·45°-ϕo/2]] $\underline{n \cdot \pi/4-\phi_o/2}$ (where n is an integer) when an angle formed between the polarization surface of the linearly polarized light from the quarter wave plate and the electric main axis of the electro optic crystal is [[45°-ϕo]] $\underline{\pi/4-\phi_o}$ without the electric field applied.

Please replace paragraph **[0059]** with the following amended paragraph:

[0059] In order to achieve the above objects, according to a twenty-second aspect of the invention, there is provided a method of adjusting an electric field sensor including: a light source; an electro optic crystal which is applied with an electric field based on a signal under test, in which a birefringent index changes according to the electric field, and which changes a polarization state of a linearly polarized light whose polarization surface forms an angle [[45°]] $\pi/4$ with an electric main axis of the electro optic crystal according to the birefringent index and emits the light; a pair of electrodes for applying the electric field based on the signal under test to the electro optic crystal; and a detector that splits the light emitted from the electro optic crystal into a P polarized light component and an S polarized light component, and obtains an alternate current signal corresponding to a difference between intensities of the respective polarized light components, the method including: providing a quarter wave plate that converts an elliptically polarized light emitted from the electro optic crystal into a linearly polarized light such that an electric main axis of the quarter wave plate forms an angle [[45°]] $\pi/4$ with an electric main axis of the electro optic crystal; and providing a half wave plate that adjusts an angle of a polarization surface of the linearly polarized light emitted from the quarter wave plate such that an angle formed between an electric main axis of the half wave plate and the electric main axis of the electro optic crystal becomes [[n·45°-φo/2]] $n \cdot \pi/4-\phi_0/2$ (where n is an integer) when a phase difference included

in the elliptically polarized light emitted from the electro optic crystal is [[ϕo]] $\underline{\phi_o}$ without the electric field applied.

Please replace paragraph **[0060]** with the following amended paragraph:

[0060] In order to achieve the above objects, according to a twenty-third aspect of the invention, there is provided a method of adjusting an electric field sensor including: a light source; an electro optic crystal which is applied with an electric field based on a signal under test, in which a birefringent index changes according to the electric field, and which changes a polarization state of incident circularly polarized light according to the birefringent index and emits the light; a pair of electrodes for applying the electric field based on the signal under test to the electro optic crystal; and a detector that splits the light emitted from the electro optic crystal into a P polarized light component and an S polarized light component, and obtains an alternate current signal corresponding to a difference between intensities of the respective polarized light components, the method including: providing a quarter wave plate that converts an elliptically polarized light emitted from the electro optic crystal into a linearly polarized light such that an electric main axis of the quarter wave plate forms an angle [[45°]] $\underline{\pi/4}$ with an electric main axis of the electro optic crystal; and providing a half wave plate that adjusts an angle of a polarization surface of the linearly polarized light emitted from the quarter wave plate such that an angle formed between an electric main axis of the half wave plate and the electric main axis of the electro optic crystal becomes [[n·45°-ϕo/2]] $\underline{n\cdot\pi/4-\phi_o/2}$ (where **n** is an integer) when a phase difference included in the elliptically

polarized light emitted from the electro optic crystal is [[ϕo]] $\underline{\phi_o}$ without the electric field applied.

Please replace paragraph **[0061]** with the following amended paragraph:

[0061] According to a twenty-fourth aspect of the invention, there is provided the method of adjusting an electric field sensor according to any one of the twenty-first to the twenty-third aspects of the invention, wherein [[ϕo]] $\underline{\phi_o}$ is determined based on [[ϕo=(2π/λ)(no-ne)L]] $\underline{\phi_o=(2\pi/\lambda)(n_o-n_e)L}$, where

Please replace paragraph **[0062]** with the following amended paragraph:

[0062] [[no]] $\underline{n_o}$ is a refractive index of the electro optic crystal for ordinary light,

Please replace paragraph **[0063]** with the following amended paragraph:

[0063] [[ne]] $\underline{n_e}$ is a refractive index of the electro optic crystal for extraordinary light,

Please replace paragraph **[0064]** with the following amended paragraph:

[0064] λ is a wavelength <u>(meter)</u> of light in vacuum, and

Please replace paragraph **[0065]** with the following amended paragraph:

[0065] L is a length <u>(meter)</u> of the electro optic crystal in the direction of light.

Please replace paragraph **[0066]** with the following amended paragraph:

[0066] According to a twenty-fifth aspect of the invention, there is provided the method of adjusting an electric field sensor according to any one of the twenty-first to the twenty-third aspects of the invention, wherein [[ϕo]] $\underline{\phi_o}$ is determined by measurement.

Please replace paragraph **[0109]** with the following amended paragraph:

[0109] In the electric field sensor according to the first embodiment, a linearly polarized light emitted from the light source 1 is incident to the EO crystal 7. In this case, a polarization surface of the linearly polarized light at a point A is set to form an angle [[45°]] $\underline{\pi/4}$ with an electric main axis of the EO crystal 7.

Please replace paragraph **[0110]** with the following amended paragraph:

[0110] The EO crystal 7 has natural birefringence. When an electric field is not applied to the EO crystal 7, light at a point B is an elliptically polarized light. An electric main axis of the QWP 6 is set to form an angle [[45°]] $\underline{\pi/4}$ with the electric main axis of the EO crystal 7. The elliptically polarized light at the point B is converted into a linearly polarized light when the elliptically polarized light passes through the QWP 6 having the above setting. Therefore, the light at a point C is the linearly polarized light. However, in general, an angle formed by the polarization surface of the linearly polarized light and the electric main axis of the EO crystal 7 is different from the corresponding angle at the point A. The HWP 8 disposed at a suitable angle converts the linearly polarized light at the point C into a linearly polarized light that includes a P polarized light component and an S polarized light

component to the PBS 9 at a ratio of 1:1. The P polarized light is a linearly polarized light that passes through the PBS 9, and the S polarized light is a linearly polarized light that is reflected from the PBS 9. While the PBS 9 can be optionally disposed, it is usual that the PBS 9 is disposed to split the P polarized light from the S polarized light within a horizontal surface (x-z surface). Therefore, this usual layout is employed in the present embodiment, and the subsequent explanation is based on this assumption.

Please replace paragraph **[0111]** with the following amended paragraph:

[0111] The polarization surface of the P polarized light coincides with the x-z horizontal surface, and the polarization surface of the S polarized light coincides with the y-z horizontal surface. Therefore, the polarization surface of the linearly polarized light at a point D forms an angle [[45°]] $\underline{\pi/4}$ with the x-z horizontal surface.

Please replace paragraph **[0112]** with the following amended paragraph:

[0112] Since the P component and the S component are included at a ratio of 1:1 in the linearly polarized light at the point D, the PD 19 and the PD 17 detect equivalent light amount. Since the PDs 19 and 17 output electric signals of a level proportional to the intensity of the received light, respectively, a level of the electric signal output from the differential amplifier 21 is zero. When an electric field is applied to the EO crystal 7, the angle formed between the polarization surface of the linearly polarized light and the x-z horizontal surface at the point D is deviated by δ from [[45°]] $\underline{\pi/4}$. δ is proportional to an

amplitude A of the electric field in the EO crystal 7. Therefore, when the electric field is applied, unbalance occurs between the light amount detected by the PD 17 and that detected by the PD 19, and the differential amplifier 21 outputs an electric signal of a level proportional to the electric field A. Consequently, the electric field applied to the EO crystal 7 can be detected, by detecting the electric signal output from the differential amplifier 21. The electric field in the EO crystal 7 is proportional to a potential difference between the electrodes attached to the EO crystal 7. Therefore, a detection of the electric signal output from the differential amplifier 21 is equivalent to a detection of a potential difference between the electrodes.

Please replace paragraph **[0114]** with the following amended paragraph:

[0114] Fig.8(a) shows a polarization state of light at the point A. The polarization surface of a linearly polarized light forms an angle [[45°]] <u>π/4</u> with the x axis (the slow axis of the EO crystal 7).

Please replace paragraph **[0115]** with the following amended paragraph:

[0115] Fig.8(b) shows a polarization state of light at the point B. The light becomes an elliptically polarized light due to birefringence of the EO crystal 7. The main axis of this ellipse forms an angle [[45°]] <u>π/4</u> with the x axis.

Please replace paragraph **[0116]** with the following amended paragraph:

[0116] Fig.8(c) shows a relationship between the polarization state of light at the point C and the electric main axis of the QWP 6. An s axis and an f axis express a slow axis and a fast axis of the QWP 6, respectively. The s axis forms an angle [[45°]] $\underline{\pi/4}$ with the x axis. The elliptically polarized light at the point B is converted into a linearly polarized light. When a phase difference generated between independent polarized light components of light due to natural birefringence of the EO crystal 7 (a phase difference included in the elliptically polarized light emitted from the EO crystal 7) is denoted as [[ϕo]] $\underline{\phi_o}$, an angle formed between the polarization surface of the linearly polarized light and the x axis is [[45°-ϕo]] $\underline{\pi/4-\phi_o}$.

Please replace paragraph **[0117]** with the following amended paragraph:

[0117] Fig.8(d) shows a relationship between the polarization state of light at the point D and the electric main axis of the HWP 8. An s axis and an f axis express a slow axis and a fast axis of the HWP 8, respectively. A dotted line expresses the polarization state of the light at the point C. When an angle formed between the slow axis (s axis) of the HWP 8 with the x axis is set as follows, the angle formed between the polarization surface of the linearly polarized light and the x axis can be corrected to [[45°]] $\underline{\pi/4}$. Obviously, the angle formed between the polarization surface of the linearly polarized light at the point D and the y axis (the fast axis of the EO crystal 7) can be also corrected to [[45°]] $\underline{\pi/4}$:

[[45°-ϕo/2]] $\underline{n\cdot\pi/4-\phi_o/2}$.

Please replace paragraph **[0118]** with the following amended paragraph:

[0118] The value of [[ϕo]] $\underline{\phi_o\text{(radian)}}$ can be determined from the following expression or by measurement:

[[$\phi o=(2\pi/\lambda)(no\text{-}ne)L$]] $\underline{\phi_o=(2\pi/\lambda)(n_o\text{-}n_e)L}$

Please replace paragraph **[0119]** with the following amended paragraph:

[0119] where, λ denotes a wavelength <u>(meter)</u> of light (in the vacuum) incident to the crystal, L denotes a length <u>(meter)</u> of the crystal in the z direction, and [[no and ne]] $\underline{n_o \text{ and } n_e}$ denote refractive indices of the EO crystal 7 for normal light and extraordinary light, respectively.

Please replace paragraph **[0121]** with the following amended paragraph:

[0121] Fig.8(e) shows a change in the polarization state of light at the point D when an electric field under test A(t) is applied to the EO crystal 7. The application of an alternate current electric field having a change A(t)=[[Aosinωt]] $\underline{A_o\sin\omega t}$ is explained as an example. In this case, a phase difference $\phi(t)$ generated between independent polarized light components of light within the EO crystal 7 is expressed as $\phi(t)$=[[$\phi o+\delta o\sin\omega t$]] $\underline{\phi_o+\delta\sin\omega t}$. Therefore, at the point D, an angle $\theta(t)$ formed between the polarization surface of the linearly polarized light and the x axis oscillates between [[$\pm\delta o$]] $\underline{\pm\delta_o}$ in an angular frequency ω. This relationship is expressed as $\theta(t)$=[[$45°+\delta o\sin\omega t$]] $\underline{\pi/4+\delta_o\sin\omega t}$.

Please replace paragraph **[0124]** with the following amended paragraph:

[0124] The QWP 5 converts a linearly polarized light emitted from the light source 1 into a circularly polarized light. Therefore, the circularly polarized light is incident to the EO crystal 7. When the linearly polarized light is incident to the EO crystal 7 like in the first embodiment, in order to efficiently perform a modulation in a polarizing manner within the EO crystal 7, the polarization surface of the linearly polarized light needs to be set to form the angle [[45°]] $\underline{\pi/4}$ with the electric main axis of the EO crystal 7. On the other hand, when a circularly polarized light is used, it is not necessary to set an angle between the polarization surface and the electric main axis. Therefore, the process of manufacturing the electric field sensor according to the present invention can be simplified.

Please replace paragraph **[0126]** with the following amended paragraph:

[0126] Figs.10(a) to 10(e) show a state that a clockwise circularly polarized light is incident to the crystal. The polarization state of the electric field sensor according to the second embodiment is expressed by replacing [[ϕo]] $\underline{\phi_o}$ shown in Figs.8(a) to 8(e) with [[ϕo+90°]] $\underline{\phi_o + \pi/2}$.

Please replace paragraph **[0127]** with the following amended paragraph:

[0127] In other words, when an angle formed between the slow axis (s axis) of the HWP 8 and the x axis is set as follows, the angle formed between the polarization surface of the linearly polarized light and the x axis can be corrected to [[45°]] $\underline{\pi/4}$:

[[-ϕo/2]] $\underline{\phi_o/2}$.

Please replace paragraph **[0128]** with the following amended paragraph:

[0128] Although not shown, when a counterclockwise circularly polarized light is incident to the crystal, the polarization state of the electric field sensor is expressed by replacing [[ϕo with ϕo-90°]] $\underline{\phi_o \text{ with } \phi_o - \pi/2}$.

Please replace paragraph **[0129]** with the following amended paragraph:

[0129] From the viewpoint of the adjustment of the angle of the HWP 8 explained above, even when the angle formed between the polarization surface of the linearly polarized light from the QWP 6 and the y axis (the fast axis of the EO crystal 7) is [[45°-ϕo]] $\underline{\pi/4-\phi_o}$, the angle formed between the polarization surface of the linearly polarized light at the point D and the electric main axis of the EO crystal 7 can be corrected to [[45°]] $\underline{\pi/4}$. Further, even when the angle formed between the s axis (or the f axis) of the HWP 8 and the x axis (or the y axis) is [[n·45°-ϕo/2]] $\underline{n\cdot\pi/4-\phi_o/2}$ (where n is an integer), the angle formed between the

polarization surface of the linearly polarized light at the point D and the electric main axis of the EO crystal 7 can be corrected to [[45°]] $\underline{\pi/4}$.

Please replace paragraph **[0131]** with the following amended paragraph:

[0131] Fig.11(a) shows a waveform A(t)=[[Aosinωt]] $\underline{A_o \sin\omega t}$ of an electric field under test, and Fig.11(b) shows a phase difference δ(t)=[[δosinωt]] $\underline{\delta_o \sin\omega t}$ that is generated between independent polarized light components of light attributable to an electric field under test and a change in the birefringent index due to the electric field. The waveform of A(t) is naturally the same as that of δ(t). Fig.11(c) shows an angle θ(t)=[[45°+δosinωt]] $\underline{\pi/4+\delta_o \sin\omega t}$ that is formed between the polarization surface of the linearly polarized light at the point D in Fig.7 or Fig.9 and the x axis. This polarization surface oscillates in a sinusoidal waveform around θ(t)= [[45°]] $\underline{\pi/4}$. Fig.11(d) and Fig.11(e) show waveforms (V1(t) and V2(t)) of electric signals that are output from the PD 19 and the PD 17, respectively. Considering the fact that the levels of the electric signals output from the PD 19 and the PD 17 are proportional to the intensities of the light incident to the respective PDs and that a P polarized light and an S polarized light are incident to the PD 19 and the PD 17, respectively, the following relationships are established. However, in the last modification of the expression, a condition [[δo<<90°]] $\underline{\delta_o \ll \pi/2}$ is used. A phase change attributable to the electric field under test is generally small. Therefore, this condition is sufficiently practicable.

[[$V1(t) \propto \cos^2\theta(t)=0.5\{1-\sin 2(\delta o \sin\omega t)\} \div 0.5-\delta o \sin\omega t$]] $\underline{V_1(t) \propto \cos^2\theta(t)=0.5\{1-\sin 2(\delta_o \sin\omega t)\} \div 0.5-\delta_o \sin\omega t}$

[[$V2(t) \propto \cos^2\theta(t)=0.5\{1+\sin 2(\delta o \sin\omega t)\} \div 0.5+\delta o \sin\omega t$]]

$\underline{V_2(t) \propto \cos^2\theta(t)=0.5\{1+\sin 2(\delta_o \sin\omega t)\} \div 0.5+\delta_o \sin\omega t}$

Please replace paragraph **[0132]** with the following amended paragraph:

[0132] Therefore, V1(t) and V2(t) have the same direct current components as shown in Fig.11(d) and Fig.11(e), and change in mutually reverse phases. Fig.11(f) shows a waveform of an electric signal [[$Vdiff(t)=V2(t)-V1(t) \propto 2\delta o \sin\omega t$]] $V_{diff}(t)=V_2(t)-V_1(t) \propto 2\delta_o \sin\omega t$ output from the differential amplifier 21. By carrying out a differential calculation, the direct current component can be removed, and the amplitude can be doubled. The waveform of $V_{diff}(t)$ is the same as the waveform of the electric field under test A(t). Therefore, by detecting $V_{diff}(t)$, information concerning A(t) can be extracted.